

## **FUSIBLE LINK AND METHOD OF PRODUCING SAID FUSIBLE LINK**

The present application is based on Japanese Patent Application No. 2002-352130, the entire contents of which are incorporated herein by reference.

### 5                    BACKGROUND OF THE INVENTION

#### 1. Field of the Invention

This invention relates to a chain-type fusible link for a large current including fuse circuit-forming members each having terminal portions interconnected in a chain-like manner  
10 through respective fusible portions, and also relates to a method of producing this fusible link.

#### 2. Related Art

Fig. 5 shows one conventional fusible link of the type described. This fusible link 1 comprises first and second fuse  
15 circuit-forming members 3 and 4, and a box-shaped housing 2 (made of a synthetic resin) in which these fuse circuit-forming members 3 and 4 mounted.

The first fuse circuit-forming member 3 includes an interconnecting plate portion 3a, a plurality of terminal  
20 portions 3c and 3c' connected to the interconnecting plate portion 3a through respective fusible portions 3b, a battery terminal 3d extending from one end of the interconnecting plate portion 3a, and a common terminal portion 5a connected to the other end of the interconnecting plate portion 3a through a  
25 fusible portion (not shown). This first fuse circuit-forming

member 3 is formed by pressing an electrically-conductive flat plate (not shown).

The second fuse circuit-forming member 4 includes an interconnecting plate portion 4a, a plurality of terminal portions 4c and 4c' connected to the interconnecting plate portion 4a through respective fusible portions 4b, and a common terminal portion 5b extending from an end of the interconnecting plate portion 4a. This second fuse circuit-forming member 4 is formed by pressing an electrically-conductive flat plate (not shown), separately from the first fuse circuit-forming member 3.

The housing 5 has a generally rectangular parallelepiped shape, and has a circuit member-receiving chamber 2b formed therein, and this chamber 2b has an opening 2a formed in an upper side of the housing. A plurality of connector housing portions 2c and a plurality of terminal support portions 2d are formed at a lower side of the circuit member-receiving chamber 2b. The opening 2a in the housing 2 is closed by a lid 6.

In the above construction, the first and second fuse circuit-forming members 3 and 4 are inserted into the circuit member-receiving chamber 2b through the opening 2a in the housing 2. When the first and second fuse circuit-forming members 3 and 4 are completely received in the circuit member-receiving chamber 2b, the interconnecting plate portions 3a and 4a of the first and second fuse circuit-forming

members 3 and 4 are located in the circuit member-receiving chamber 2b, and also the terminal portions 3c, 3c', 4c and 4c' are set in their respectively predetermined positions in the connector housing portions 2c and terminal support portions 2d.

5        Then, the common terminal portions 5a and 5b of the first and second fuse circuit-forming members 3 and 4 are fastened to the housing by a bolt 7. As a result, the first and second fuse-forming members 3 and 4 are electrically connected together, so that desired fuse circuits are formed by the first  
10      and second fuse circuit-forming members 3 and 4.

      The battery terminal 3d of the first fuse circuit-forming member 3 is fastened to the housing 2 by a bolt (not shown). A terminal of a battery cable (not shown) is connected to the battery terminal 3d, and terminals of each of mating connectors  
15      are connected respectively to the terminal portions 3c and 4c in the corresponding connector housing 2c, and LA terminals (not shown) are connected by screw-fastening respectively to the terminal portions 3c' and 4c' received in the terminal support portions 2d. The terminals of the mating connectors and the  
20      LA terminals are connected to loads via cables (not shown), and electric power is distributed and supplied from a battery to these loads via the fuse circuits.

      When a current of above a predetermined value flows through any of the fusible portion 3b, 4b, for example, in the  
25      event of a short-circuiting accident on the part of the

corresponding load, the fusible portion 3b, 4b is heated to be melted, thereby preventing an accident due to such excess current.

JP-A-2000-133114 shows another conventional fusible  
5 link.

In the above conventional fusible link 1, however, the flat plate-like first and second circuit-forming members 3 and 4, formed separately from each other, were mounted in the housing 2 to form a unit, and therefore the assembling operation  
10 was cumbersome, and besides the overall size was large. Particularly, it was necessary to secure a space for a mounting jig for mounting the first and second fuse circuit-forming members 3 and 4 in the circuit member-receiving chamber 2b in the housing 2, and therefore the compact design was limited.  
15 Furthermore, when the number of the fuse circuits was increased, the housing of a large size must be used.

#### SUMMARY OF THE INVENTION

This invention has been made in order to solve the above problems, and an object of the invention is to provide a fusible  
20 link, in which a sufficient number of fuse circuits can be secured, and the overall size can be made small, and also to provide a method of producing this fusible link.

(1) The invention is directed to a fusible link including a plurality of fuse circuit-forming members each having a  
25 plurality of terminal portions which are arranged in a

chain-like manner, and are connected to an interconnecting plate portion through respective fusible portions, and the plurality of fuse circuit-forming members being mounted on a housing to form large-current fuse circuits; characterized in that a bending portion is formed integrally at a generally central portion of the interconnecting plate portion, and the fuse circuit-forming members are formed integrally respectively at opposite sides of the bending portion, and the bending portion and the fuse circuit-forming members are formed by an electrically-conductive flat plate; and insulating housings, forming the housing, are formed integrally respectively on the fuse circuit-forming members by insert molding; and the bending portion is bent at its predetermined portion in such a manner that the housings are disposed in parallel opposed relation to each other.

In this fusible link, the bending portion of the interconnecting plate portion is bent at its predetermined portion in such a manner that the two housings, formed integrally respectively (by insert molding) on the fuse circuit-forming members provided respectively at the opposite sides of the bending portion, are disposed in parallel opposed relation to each other. Therefore, by bending the single flat plate, the fuse circuits, generally equal in number to fuse circuits obtained with two plate plates, can be secured. And besides, it is not necessary to secure a space for a mounting

jig for mounting the pair of circuit-forming members in the housing, and therefore the whole of the fusible link can be formed into a compact design.

(2) The fusible link of the invention is further characterized in that a plurality of ribs are formed integrally with and project from an outer surface of each of the housings in such a manner that the two adjacent ribs are disposed respectively at opposite sides of each of the terminal portions in opposed relation to each other.

In this fusible link, a terminal receiving portion for receiving a mating terminal for connection to the terminal portion is formed between the opposed ribs disposed respectively at the opposite sides of each terminal portion.

(3) The fusible link of the invention is further characterized in that a retaining portion is formed on one of the two housings, while an engagement portion for retaining engagement with the retaining portion to hold the housings in parallel opposed relation to each other is formed on the other housing.

In this fusible link, when the bending portion is bent, the retaining portion on the one housing is retainingly engaged with the engagement portion on the other housing, thereby positively holding the two housings in parallel opposed relation to each other.

(4) The invention is directed to a method of producing

a fusible link including a plurality of fuse circuit-forming members each having a plurality of terminal portions which are arranged in a chain-like manner, and are connected to an interconnecting plate portion through respective fusible  
5 portions, the plurality of fuse circuit-forming members being mounted on a housing to form large-current fuse circuits; characterized in that a bus bar is formed by pressing a single electrically-conductive flat plate in such a manner that a bending portion is formed at a generally central portion of the  
10 flat plate while the fuse circuit-forming members are formed respectively at opposite sides of the bending portion, and subsequently insulating housings, forming the housing, are formed integrally respectively on the fuse circuit-forming members, provided respectively at the opposite sides of the  
15 bending portion of the bus bar, by insert molding; and subsequently the bending portion of the bus bar is bent at its predetermined portion in such a manner that the housings are disposed in parallel opposed relation to each other while a retaining portion of one of the two housings is retainingly  
20 engaged with an engagement portion of the other housing, thereby assembling and producing the fusible link.

In this fusible link-producing method, the fusible links can be mass-produced at low costs merely by effecting the simple operation in which the bending portion of the bus bar is bent  
25 at its predetermined portion in such a manner that the two

housings, provided respectively at the opposite sides of the bending portion, are disposed in parallel opposed relation to each other.

#### BRIEF DESCRIPTION OF THE DRAWINGS

5        Fig. 1 is a perspective view showing one preferred embodiment of a fusible link of the invention.

       Fig. 2 is a perspective view of a bus bar used in the fusible link, showing a condition before the bus bar is bent.

       Fig. 3 is a perspective view of the bus bar, showing a  
10    condition after the bus bar is bent.

       Fig. 4 is a perspective view showing a condition in which housings are formed integrally respectively on opposite side portions of the bus bar (which is not yet bent) by insert molding.

       Fig. 5 is a perspective view of a conventional fusible  
15    link.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

       One preferred embodiment of the present invention will now be described with reference to the drawings.

       Fig. 1 is a perspective view showing one preferred  
20    embodiment of a fusible link of the invention, Fig. 2 is a perspective view of a bus bar used in the fusible link, showing a condition before the bus bar is bent, Fig. 3 is a perspective view of the bus bar, showing a condition after the bus bar is bent, and Fig. 4 is a perspective view showing a condition in  
25    which housings are formed integrally respectively with opposite



side portions of the bus bar (which is not yet bent) by insert molding.

As shown in Figs. 1 and 4, the fusible link 10 comprises the flat plate-like bus bar 11 of an electrically-conductive nature, and the pair of insulating housings 21 and 21'. The bus bar 11 has fuse circuit-forming members 13 and 13' (which form large-current fuse circuits) integrally formed respectively at opposite sides of a bending portion 12 formed generally at a central portion of the bus bar 11. The housings 21 and 21' are formed integrally respectively one the pair of fuse circuit-forming members 13 and 13' by insert molding a synthetic resin. The bending portion 12 is bent in such a manner that the pair of housings 21 and 21' are disposed in parallel opposed relation to each other, thereby forming the fusible link 10.

As shown in Fig. 2, the bending portion 12 of the bus bar 11 is formed integrally at a generally central portion of an interconnecting plate portion 14 of the pair of fuse circuit-forming members 13 and 13'. By pressing a single flat plate P of an electrically-conductive nature, the pair of fuse circuit-forming members 13 and 13' are integrally formed respectively at the opposite sides of the bending portion 12. Namely, by pressing this plate P, there is formed the bus bar 11 having the pair of fuse circuit-forming members 13 and 13' provided respectively at the opposite sides of the bending

portion 12. Two pairs of grooves 12a are formed at a generally central portion of the bending portion 12 by pressing, and extend in an upward-downward direction, the two pair of grooves 12a being spaced a predetermined distance from each other. The bending portion 12 can be easily bent inwardly along the pairs of grooves 12a. An extension portion 12b of a rectangular shape is integrally formed with and projects from an upper edge of the central portion of the bending portion 12, and this extension portion 12b is bent inwardly at right angles to form an alternator terminal portion 19.

As shown in Figs. 2 and 3, the fuse circuit-forming member 13 includes the elongate and narrow interconnecting plate portion 14 of a rectangular shape extending from one side edge of the bending portion 12 at an upper end portion thereof, a plurality of screw-fastening terminal portions 16 which are connected to this interconnecting plate portion 14 in a chain-like manner through respective fusible portions 15, and extend in a transverse direction, one battery terminal portion 17 which is connected directly (that is, not through a fusible portion) to one end of the interconnecting plate portion 14 remote from the bending portion 12, and extends in the transverse direction, and a fusible portion 18 (for an alternator circuit) which is formed at the other end portion of the interconnecting plate portion 14, and extends in the longitudinal direction. The fusible portions 15, as well as

the fusible portion 18, are narrow, and when an electric current of above a predetermined value flows through the fusible portions 15 and 18, the fusible portions melts. The plurality of screw-fastening terminal portions 16 and the battery  
5 terminal portion 17 are arranged in such a chain-like manner that any two adjacent terminal portions are spaced a predetermined distance from each other.

The other fuse circuit-forming member 13' includes the elongate and narrow interconnecting plate portion 14 of a  
10 rectangular shape extending from the other side edge of the bending portion 12 at the upper end portion thereof, and a plurality of screw-fastening terminal portions 16 which are connected to this interconnecting plate portion 14 in a chain-like manner through respective fusible portions 15.  
15 Each of these fusible portions 15 are narrow, and when an electric current of above a predetermined value flows through these fusible portions 15, the fusible portions 15 melt. The plurality of screw-fastening terminal portions 16 are arranged in such a chain-like manner that any two adjacent terminal  
20 portions are spaced a predetermined distance from each other.

As shown in Figs. 1 and 4, the housing 21 is formed integrally on the fuse circuit-forming member 13 by insert molding, and this housing 21 includes a housing body 22 which covers generally the whole of the fuse circuit-forming member  
25 13 (at a region extending from the right-hand grooves 12a (in

the drawings) to the distal end of the fuse circuit-forming member 13) except the fusible portions 15 and those portions of the terminal portions 16 and 17 disposed respectively around screw-fastening holes 16a, 17a and 17b thereof. A plurality  
5 of ribs 23 of a generally trapezoidal shape are formed integrally with and project from an outer surface of the housing body 22 in such a manner that the two adjacent ribs 23 and 23 are disposed respectively at opposite sides of each of the terminal portions 16 and 17 in opposed relation to each other.  
10 A space, formed between the adjacent ribs 23 and 23 disposed respectively at the opposite sides of each of the terminal portions 16 and 17, forms a terminal receiving portion for receiving a corresponding mating terminal. The housing body 22 also has a plurality of ribs 24 formed integrally therewith  
15 and projecting from the outer and inner surfaces thereof, the two adjacent ribs 24 and 24 being disposed respectively at opposite sides of each of the fusible portions 15.

A rib 25 is formed integrally on the inner surface (reverse surface) of the housing body 22, and is disposed outwardly of  
20 the pair of grooves 12a in the bending portion 12, and when the bending portion 12 is bent inwardly, the alternator terminal portion 19 rests on the rib 25. A projecting portion 26 is formed on and projects perpendicularly from the reverse surface of the housing body 22 at the distal end thereof disposed at  
25 the battery terminal portion 17. The projecting portion 26 has

a width substantially equal to a width L of an exposed portion of the bending portion 12, and when the bending portion 12 is bent inwardly along the two pairs of grooves 12a, the two housings 21 and 21' are disposed in parallel opposed relation to each other through this projecting portion 26. A pair of elastic piece portions (retaining portions) 27 and 27 are formed integrally with and project from a lower end portion of the projecting portion 26.

As shown in Figs. 1 and 4, the other housing 21' is formed integrally with the other fuse circuit-forming member 13' by insert molding, and this housing 21' includes a housing body 22' which covers generally the whole of the fuse circuit-forming member 13' (at a region extending from the left-hand grooves 12a (in the drawings) to the distal end of the fuse circuit-forming member 13') except the fusible portions 15 and those portions of the terminal portions 16 disposed respectively around screw-fastening holes 16a thereof. A plurality of ribs 23 of a generally trapezoidal shape are formed integrally with and project from an outer surface of the housing body 22' in such a manner that the two adjacent ribs 23 and 23 are disposed respectively at opposite sides of each of the terminal portions 16 in opposed relation to each other. A space, formed between the adjacent ribs 23 and 23 disposed respectively at the opposite sides of each of the terminal portions 16, forms a terminal receiving portion for receiving a corresponding

1 mating terminal. The housing body 22' also has a plurality of  
2 ribs 24 formed integrally therewith and projecting from the  
3 outer and inner surfaces thereof, the two adjacent ribs 24 and  
4 24 being disposed respectively at opposite sides of each of the  
5 fusible portions 15.

6 A rib 25 is formed integrally on the inner surface (reverse  
7 surface) of the housing body 22', and is disposed outwardly of  
8 the pair of grooves 12a in the bending portion 12, and when the  
9 bending portion 12 is bent inwardly, the alternator terminal  
10 portion 19 rests on the rib 25. A recess 28 for receiving distal  
11 ends of the pair of elastic piece portions 27 and 27 of the  
12 housing 21 is formed in that portion of the housing 22' which  
13 is to be opposed to the pair of elastic piece portions 27 and  
14 27. A pair of engagement projections (engagement portions) 29  
15 and 29 are formed integrally on upper and lower surfaces of the  
16 recess 28, respectively, and hooks 27a and 27a, formed  
17 respectively at the distal ends of the pair of elastic piece  
18 portions 27 and 27, can be brought into and out of retaining  
19 engagement with the pair of engagement projections 29 and 29,  
20 respectively. When the bend portion 12 of the bus bar 11 is  
21 bent inwardly along the two pairs of grooves 12a and 12a, the  
22 two housings 21 and 21' are held in parallel opposed relation  
23 to each other by retainingly engaging the pair of elastic piece  
24 portions 27 and 27 respectively with the pair of engagement  
25 projections 29 and 29.

The upper sides of the housings 21 and 21', disposed in parallel opposed relation to each other, are covered with a cover (not shown) made of a synthetic resin.

When the fusible link 10 of this embodiment is to be produced, first, the single flat metal plate P is pressed, thereby forming the bus bar 11 which includes the bending portion 12 formed generally at the central portion thereof, and the pair of fuse circuit-forming members 13 and 13' provided respectively at the opposite sides of the bending portion 12, as shown in Fig. 2.

Then, the housings 21 and 21' are formed integrally respectively on the fuse circuit-forming members 13 and 13' (formed respectively at the opposite sides of the bending portion 12 of the bus bar 11) by insert molding the synthetic resin as shown in Fig. 4. Then, the bending portion 12 of the bus bar 11 is bent inwardly at the two pairs of grooves 12a, so that the two housings 21 and 21' are disposed in parallel relation to each other, and the hooks 27a and 27a, formed respectively at the distal ends of the pair of elastic piece portions 27 and 27 on the one housing 21, are retainingly engaged respectively with the pair of engagement projections 29 and 29 formed on the other housing 21', thereby producing the fusible link 10 as shown in Fig. 1.

LA (round) terminals (not shown) of a battery cable are connected to the exposed battery terminal portion 17, exposed

from the one housing 21, by bolts and nuts, and terminals (not shown) of an alternator cable (not shown) are connected to the alternator terminal portion 19 by bolts and nuts. LA terminals (not shown), serving as mating terminals, are connected  
5 respectively to the exposed screw-fastening terminal portions 16 of each of the housings 21 and 21' by nuts and screws. These LA terminals are connected to various loads (not shown) via cables.

Electric power is distributed and supplied from the  
10 battery and the alternator to these loads via the fuse circuits formed by the fuse circuit-forming members 13 and 13' of the fusible link 10. When electric power in the battery is decreased, electric power is supplied from the alternator to the battery, thereby charging the battery. When a current of  
15 above a predetermined value flows through any of the fusible portion 15 and 18, for example, in the event of a short-circuiting accident on the part of the corresponding load, this fusible portion 15, 18 is heated to be melted, thereby preventing an accident due to such excess current.

20 Thus, the fusible link 10 can be assembled and produced merely by effecting the simple operation in which the bending portion 12 is bent at the grooves 12a in such a manner that the two housings 21 and 21', provided respectively at the opposite sides of the bending portion 12, are disposed in parallel  
25 relation to each other. Therefore, the compact fusible links



10 can be mass-produced at low costs.

The resin-molded housings 21 and 21' are formed integrally respectively on the fuse circuit-forming members 13 and 13' provided respectively at the opposite sides of the bending portion 12 of the bus bar 11, and it is not necessary to secure a space for a mounting jig for mounting the separate fuse circuit-forming members in the housing as in the conventional construction, and therefore the fusible link 10 can be formed into a more compact design, and besides the fuse circuits, generally equal in number to fuse circuits obtained with two bus bars, can be obtained with the single bus bar 11. Therefore, a compact and space-saving layout for the increased number of circuits can be achieved, and also the output portions can be set into an efficient connection form (existing connection form).

The plurality of ribs 23 are formed integrally with and project from the outer surface of the housing 21, 21' in such a manner that the two adjacent ribs 23 and 23 are disposed respectively at the opposite sides of each of the terminal portions 16 and 17 in opposed relation to each other, and therefore the terminal receiving portion for receiving the corresponding mating terminal is provided between any two adjacent opposed ribs 23 and 23 formed respectively at the opposite sides of the terminal portion 16, 17, and each LA terminal, connected to the terminal portion 16, 17, is

positively received between the corresponding ribs 23 and 23, and is protected by these ribs 23 and 23.

The pair of elastic piece portions 27 and 27 are formed integrally on the one housing 21, while the pair of engagement  
5 projections 29 and 29 for retaining engagement with the hooks 27a and 27a (formed respectively at the distal ends of the pair of elastic piece portions 27 and 27) to hold the pair of housings 21 and 21' in parallel opposed relation to each other are formed integrally on the other housing 21'. Therefore, when the  
10 bending portion 12 of the bus bar 11 is bent, the two housings 21 and 21' are positively held in parallel opposed relation to each other by retainingly engaging the hooks 27a of the pair of elastic piece portions 27 (formed on the one housing 21) respectively with the engagement projections 29 formed on the  
15 other housing 21'.

In the above embodiment, although the fuse circuit-forming members are arranged in two layers in parallel relation through the single bending portion, fuse circuit-forming members can be arranged in three or more layers  
20 in parallel relation through two or more bending portions.

As described above, in the fusible link of the invention, the bending portion is formed integrally at the generally central portion of the interconnecting plate portion, and the fuse circuit-forming members are formed integrally  
25 respectively at the opposite sides of the bending portion, and

the bending portion and the fuse circuit-forming members are formed by the electrically-conductive flat plate, and the insulating housings are formed integrally respectively on the fuse circuit-forming members by insert molding, and the bending  
5 portion is bent at its predetermined portion in such a manner that the housings are disposed in parallel opposed relation to each other. Therefore, a sufficient number of fuse circuits can be secured, and besides the whole of the fusible link can be formed into a compact design.

10 In the fusible link of the invention, the plurality of ribs are formed integrally with and project from the outer surface of each of the housings in such a manner that the two adjacent ribs are disposed respectively at the opposite sides of each of the terminal portions in opposed relation to each  
15 other. Therefore, the terminal receiving portion for receiving the mating terminal for connection to the terminal portion is formed between the opposed ribs disposed respectively at the opposite sides of each terminal portion.

In the fusible link of the invention, the retaining  
20 portion is formed on one of the two housings, while the engagement portion for retaining engagement with the retaining portion to hold the housings in parallel opposed relation to each other is formed on the other housing. Therefore, when the bending portion is bent, the retaining portion on the one  
25 housing is retainingly engaged with the engagement portion on

the other housing, thereby positively holding the two housings in parallel opposed relation to each other.

In the fusible link-producing method of the invention, the fusible link can be produced at low costs merely by effecting  
5 the simple operation in which the bending portion of the bus bar is bent at its predetermined portion in such a manner that the two housings, provided respectively at the opposite sides of the bending portion, are disposed in parallel opposed relation to each other. Therefore, the fusible links of a  
10 compact design can be mass-produced at low costs.